

MJO Prediction in the Climate Forecast System Version 2

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Motivation

- The MJO is a propagating tropical mode of climate variability that offers enhanced prospects for improving intraseasonal climate prediction.
- Realizing this potential is predicated on robust simulation and prediction of MJO variability.
- Societal Relevance & NOAA Interests
 - Active and break phases of Monsoon Systems.
 - Teleconnections. North American T & P.
 - Tropical Cyclone Genesis.
 - Nexus of Weather and Climate.
- 45 Day hindcasts initialized daily provide a unique dataset for examining aspects of MJO prediction.

DATA

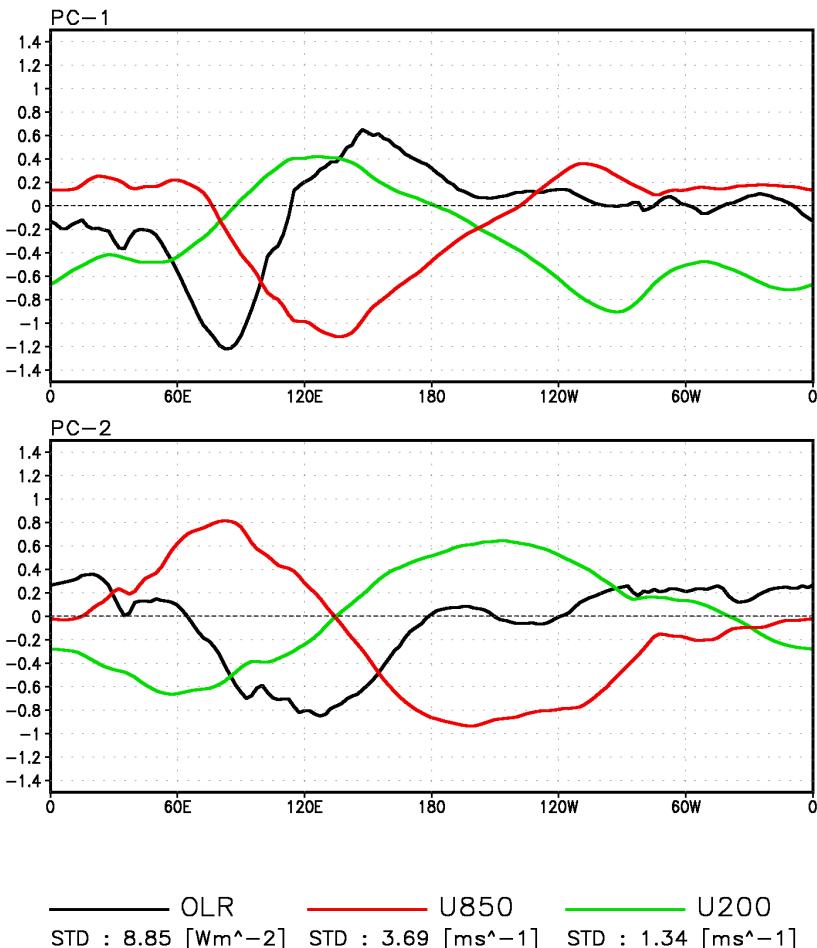
- Variables
 - U850/U200
 - OLR
- Hindcasts
 - 01Jan 1999 – 31Dec 2010
 - 4 members/day out to 45 days.
- Observations:
 - U850/U200 from CFSR
 - OLR from NOAA/AVHRR
- Intraseasonal Anomalies: $F' = F - F_c - F_L$

Where: F (total field) F_c (daily climo) F_L (previous 90-day anomaly)

MJO Definition

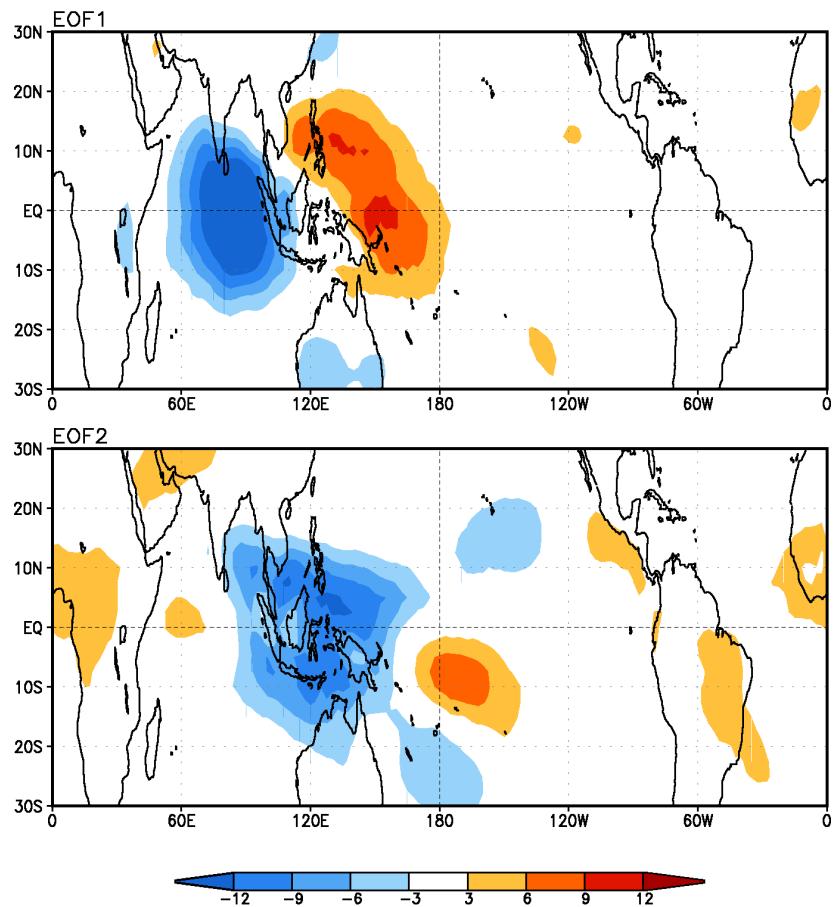
Combined EOFs (U850, U200, OLR)
Ave(5S:15N), 20-100-day filtered

Combined EOF, All Season, 1980–2010

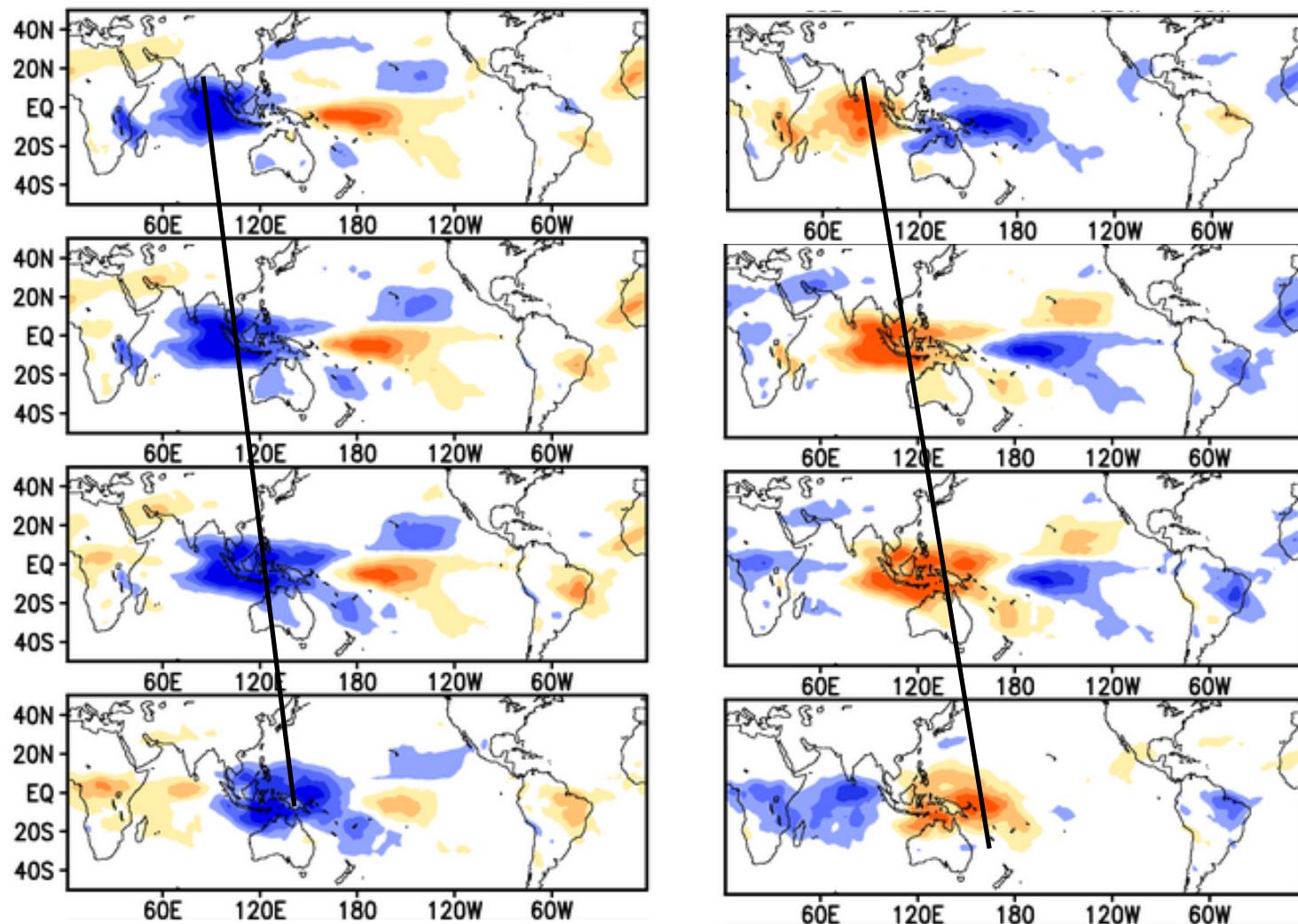


OLR EOFs (30S-30N)

OLR leading EOFs, All Season, 1980–2010

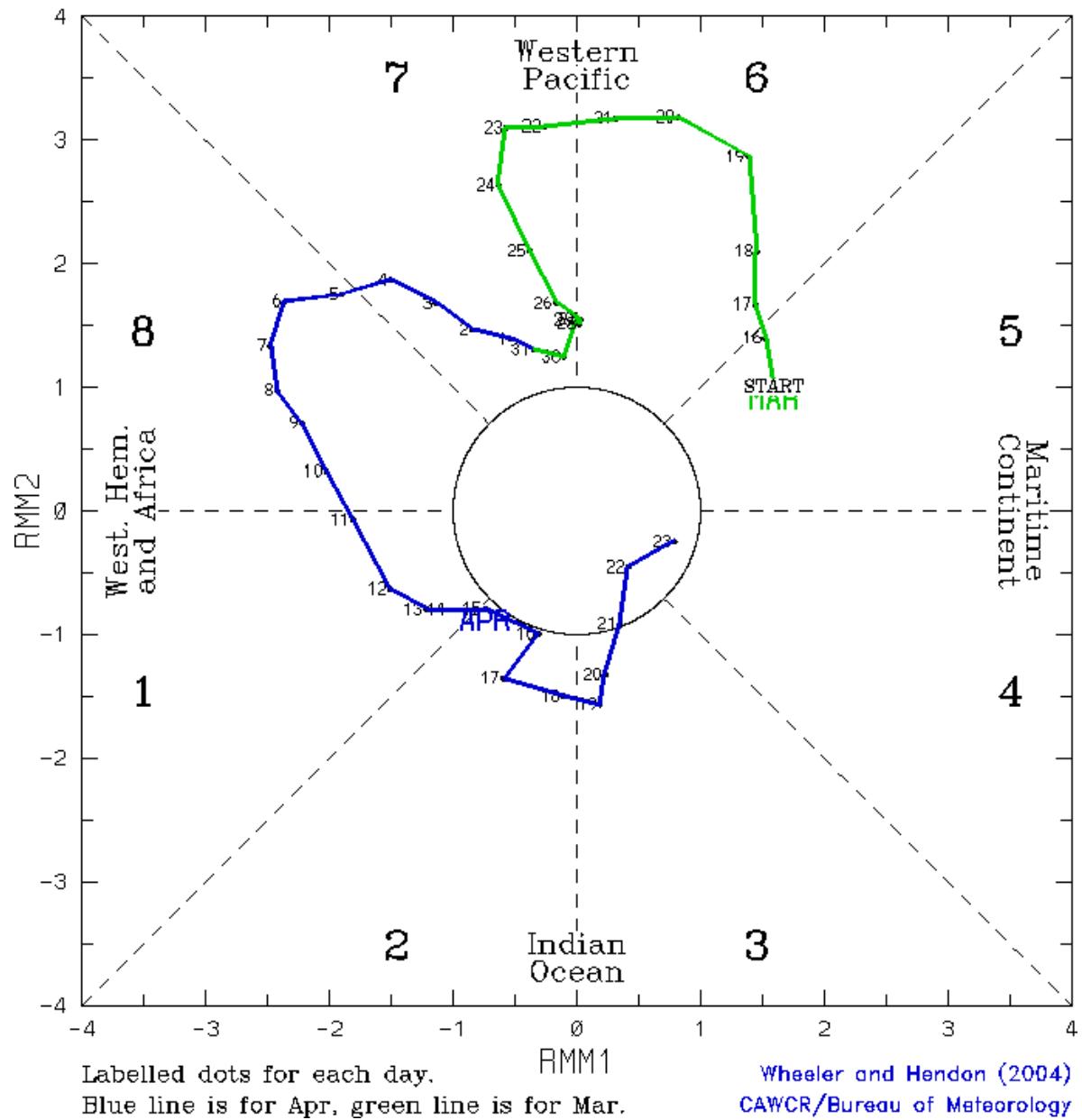


MJO Lifecycle



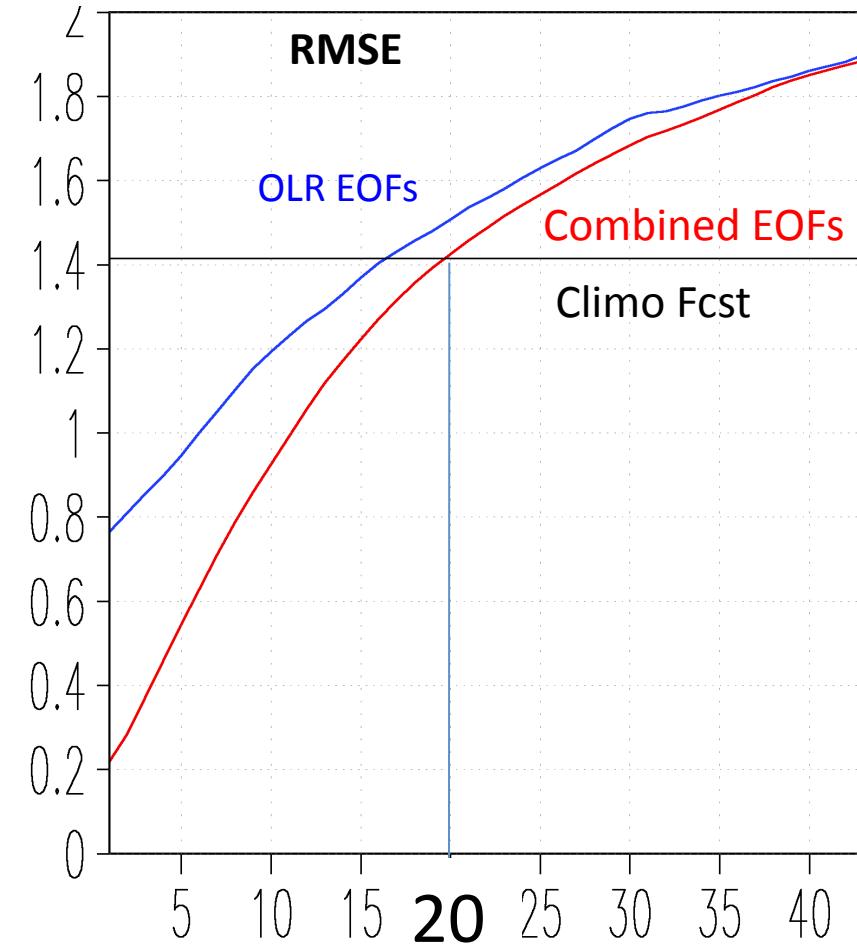
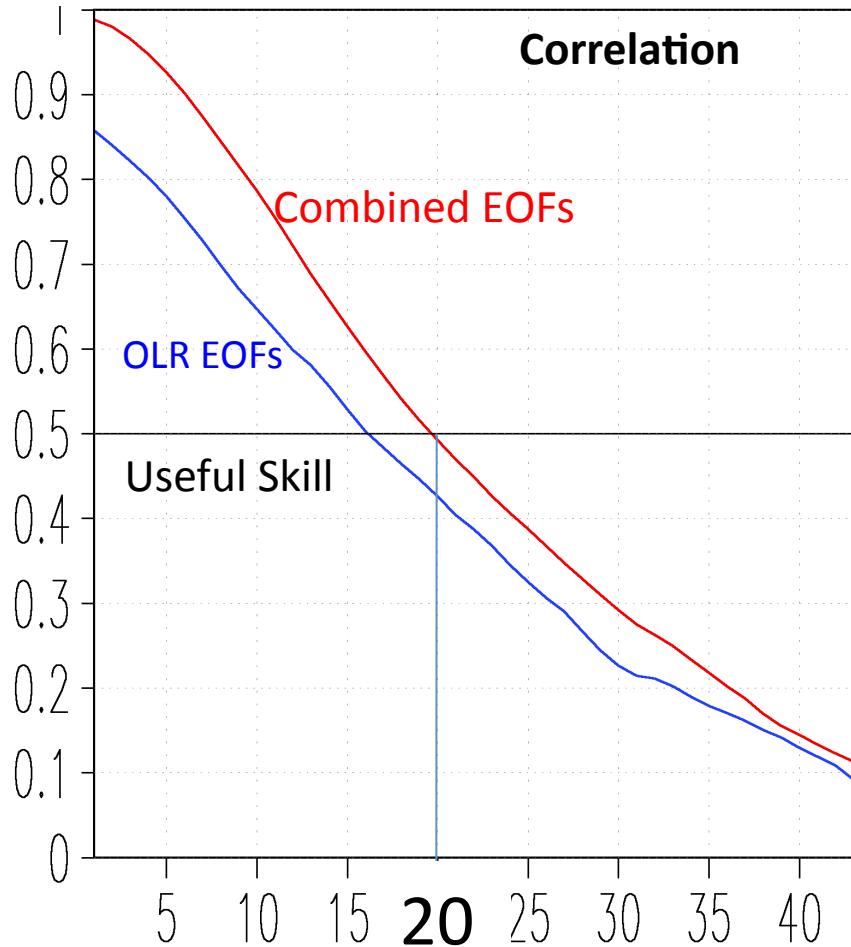
WH MJO Phase Space

(RMM1,RMM2) phase space for 15-Mar-2012 to 23-Apr-2012



PREDICTION SKILL

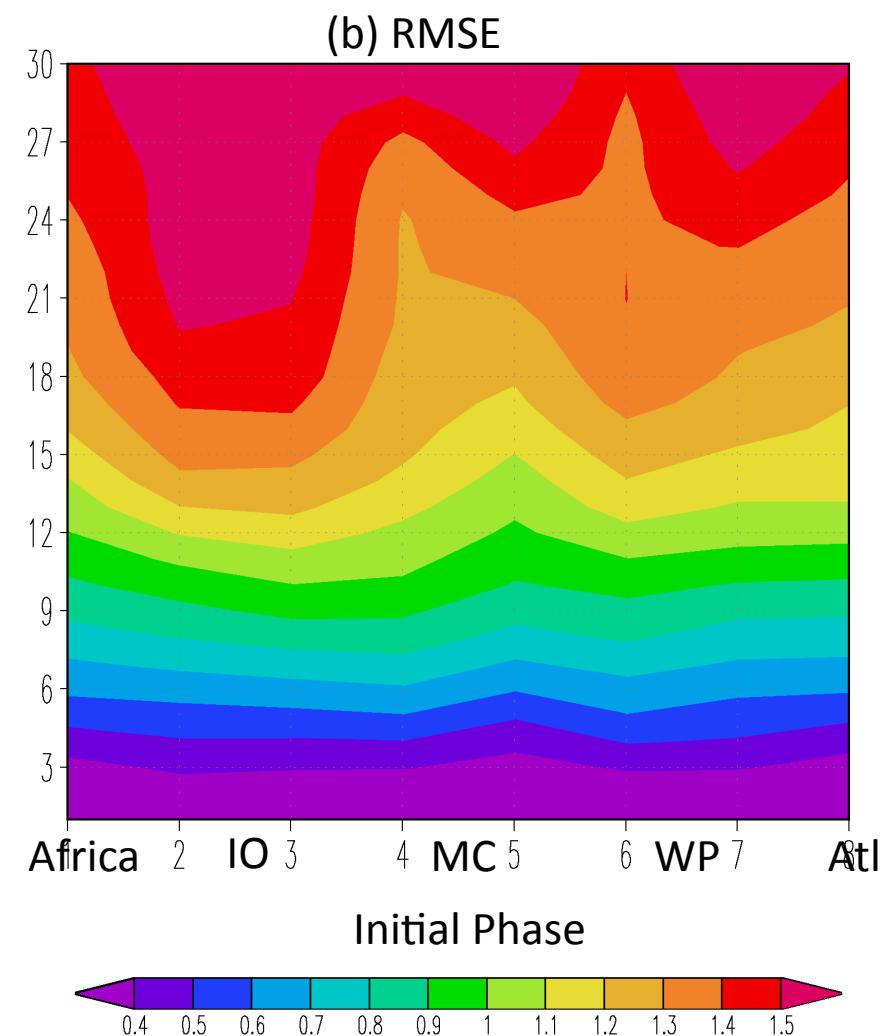
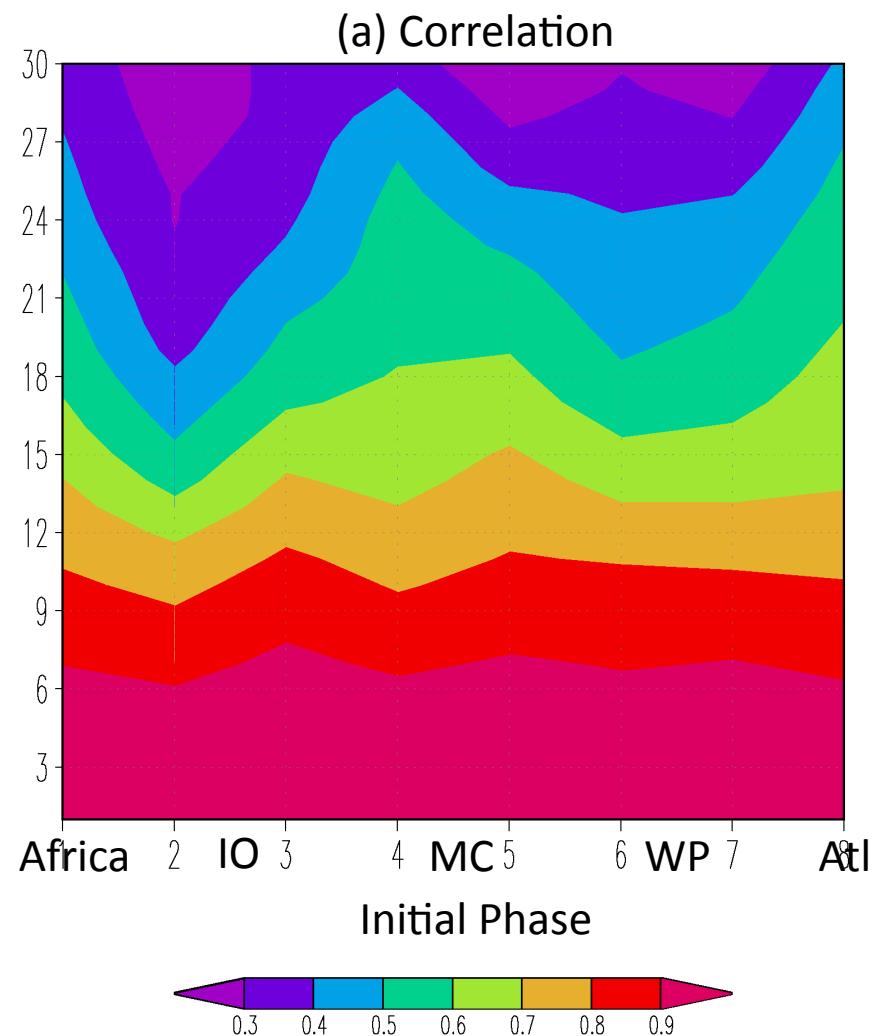
Bivariate correlation and RMSE of PCs (All Days)



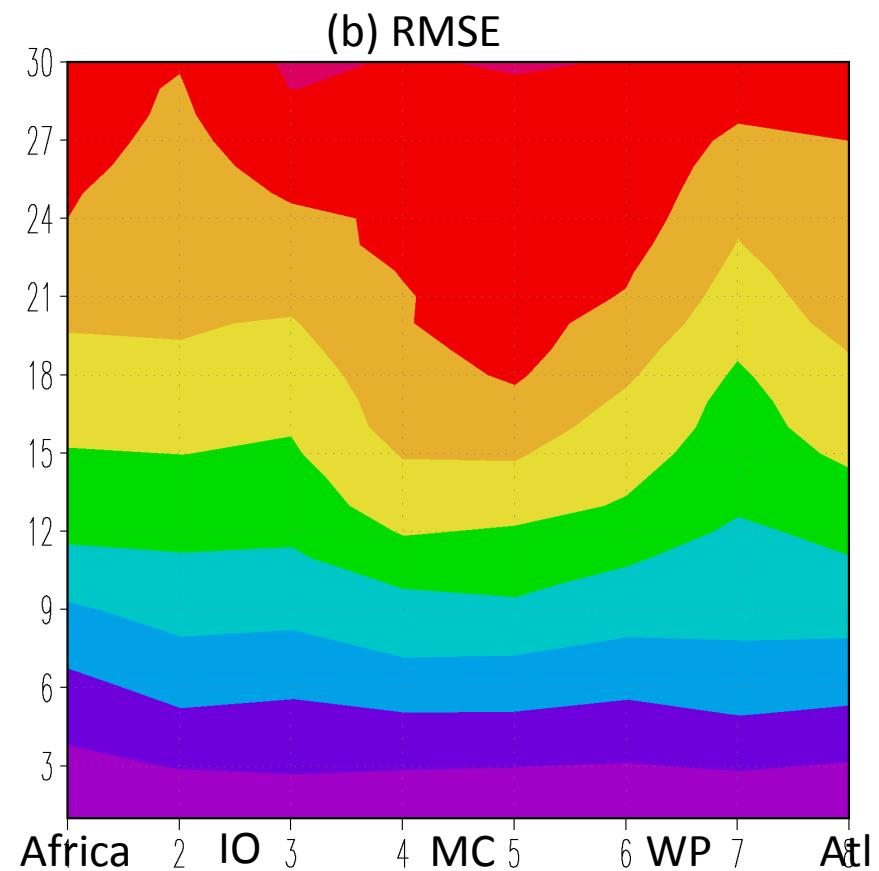
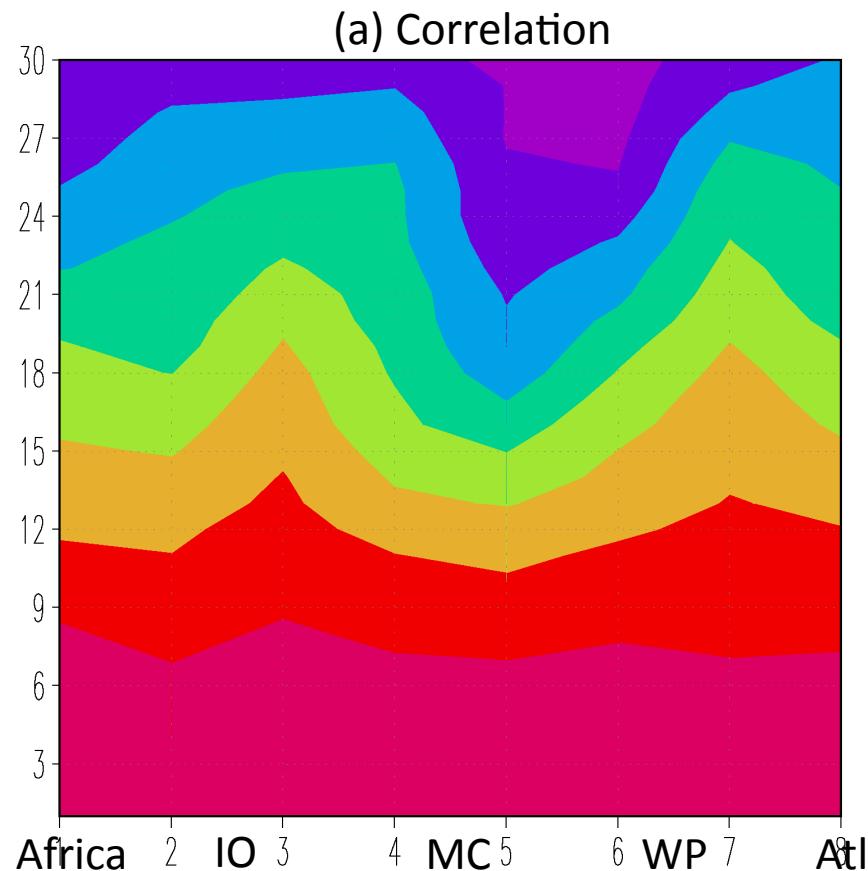
CFSv1 skill is about 10-15 days (Seo et al. 2009)

The Following analysis will be for combined EOFs

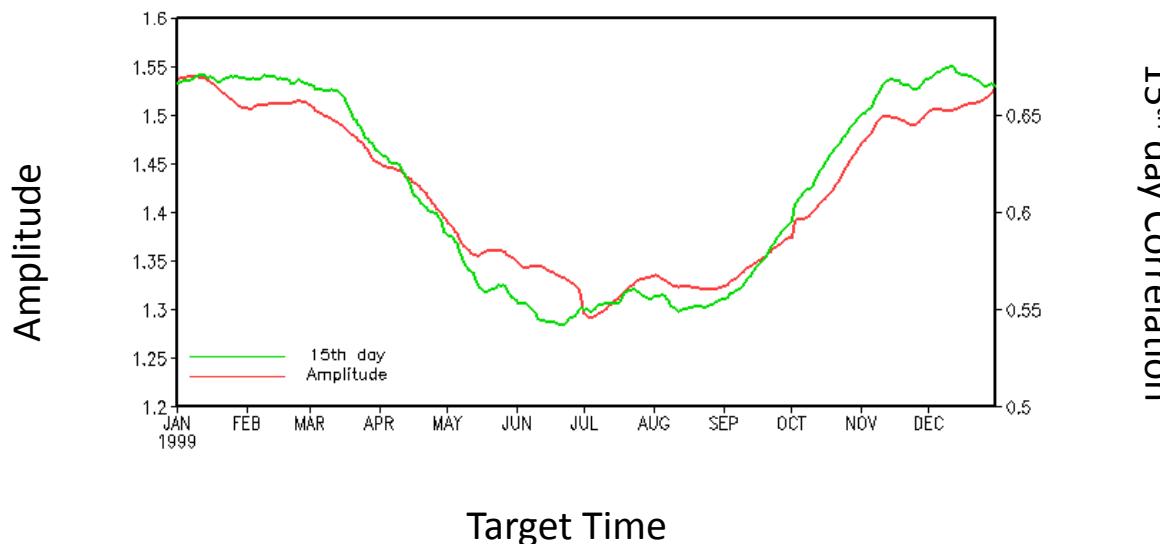
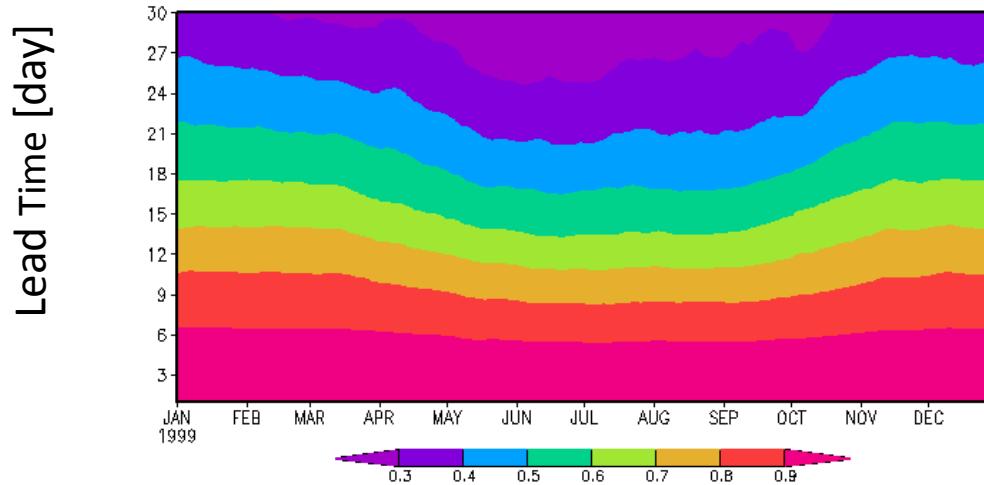
Bivariate correlation and RMSE of PCs as a function of initial phase (MJO Days)



Bivariate correlation and RMSE of PCs as a function of target phase (MJO Days)

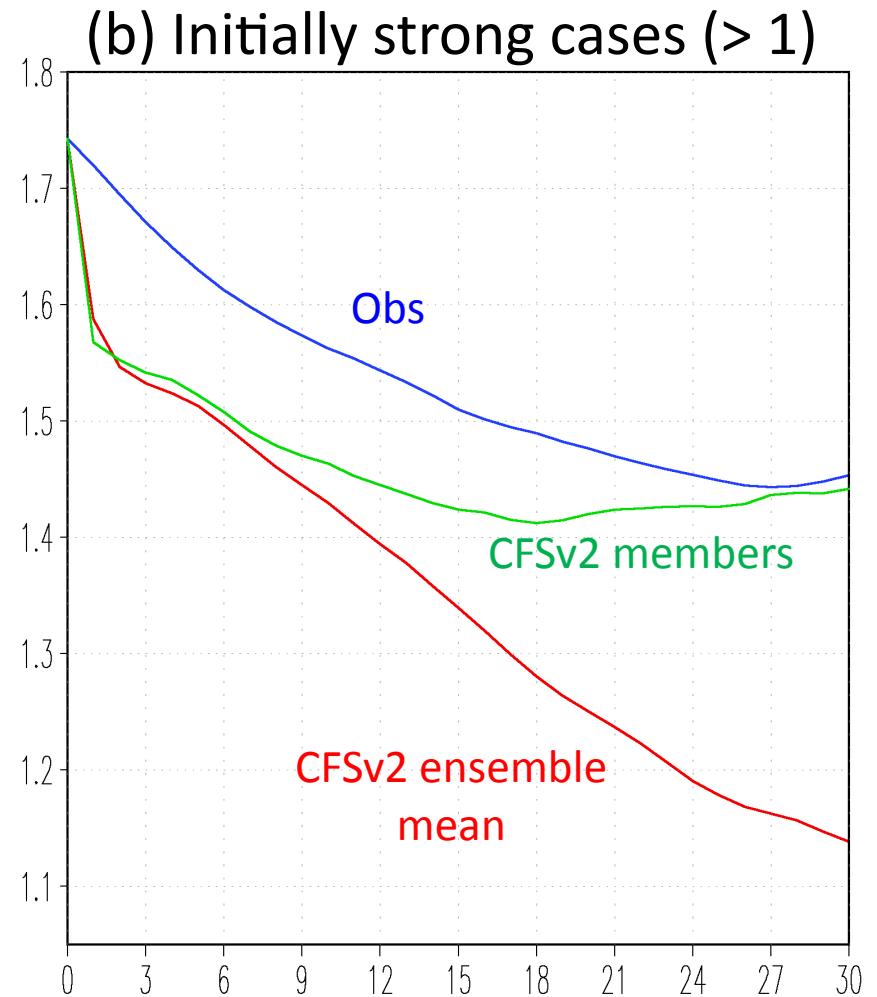
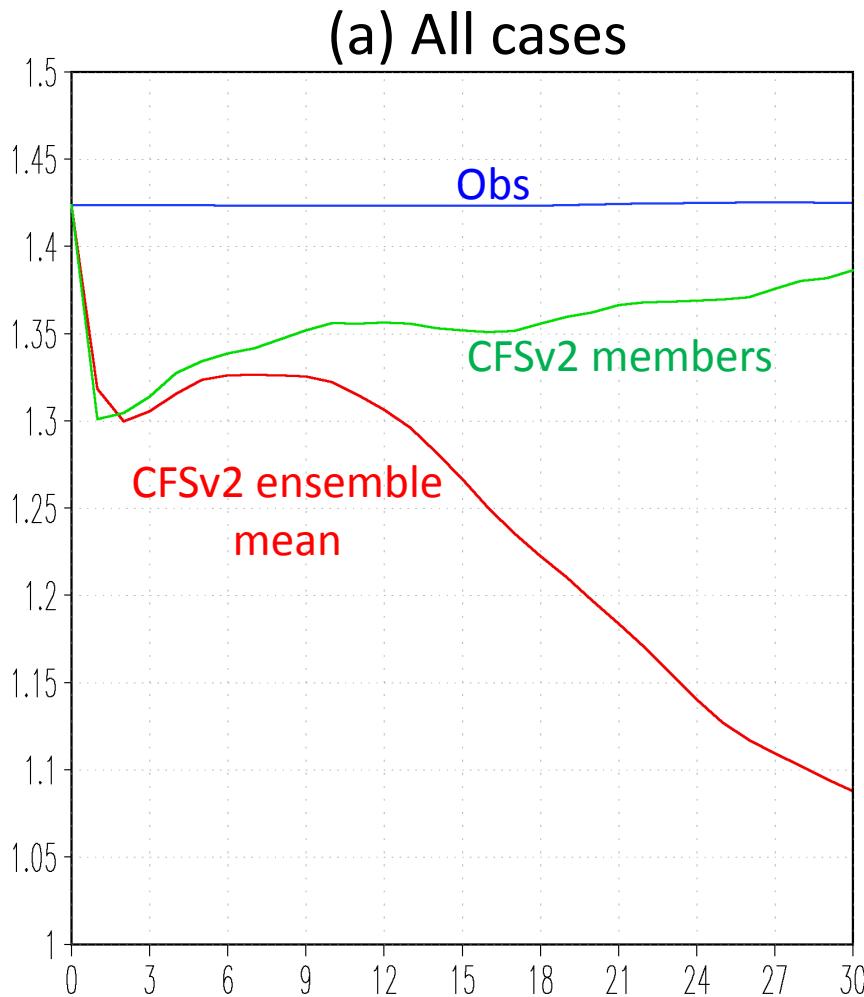


Seasonal variation of MJO forecast skill

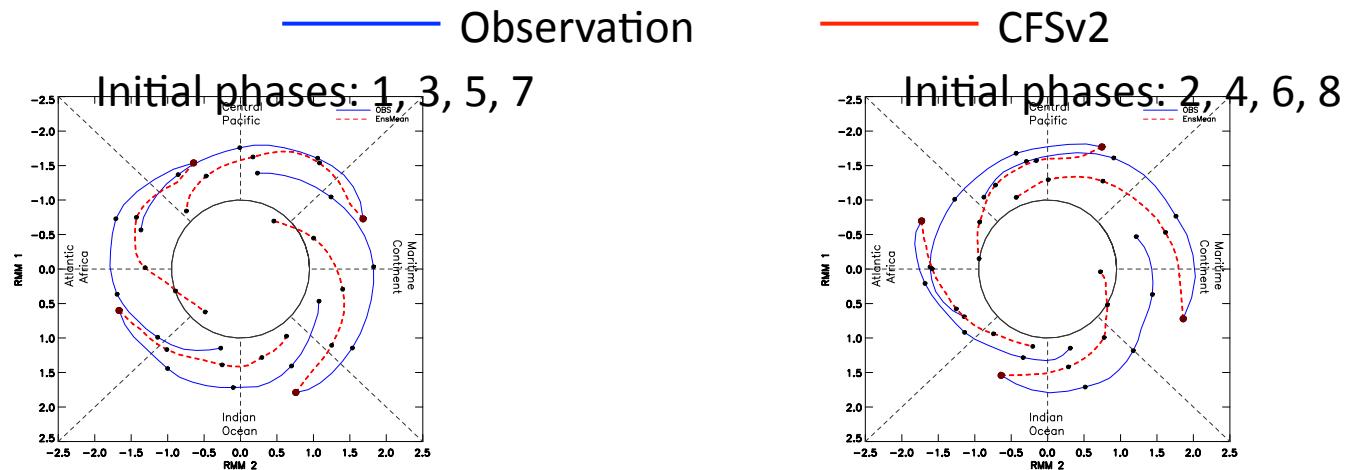


MJO MAINTENANCE

Evolution of Average Amplitude



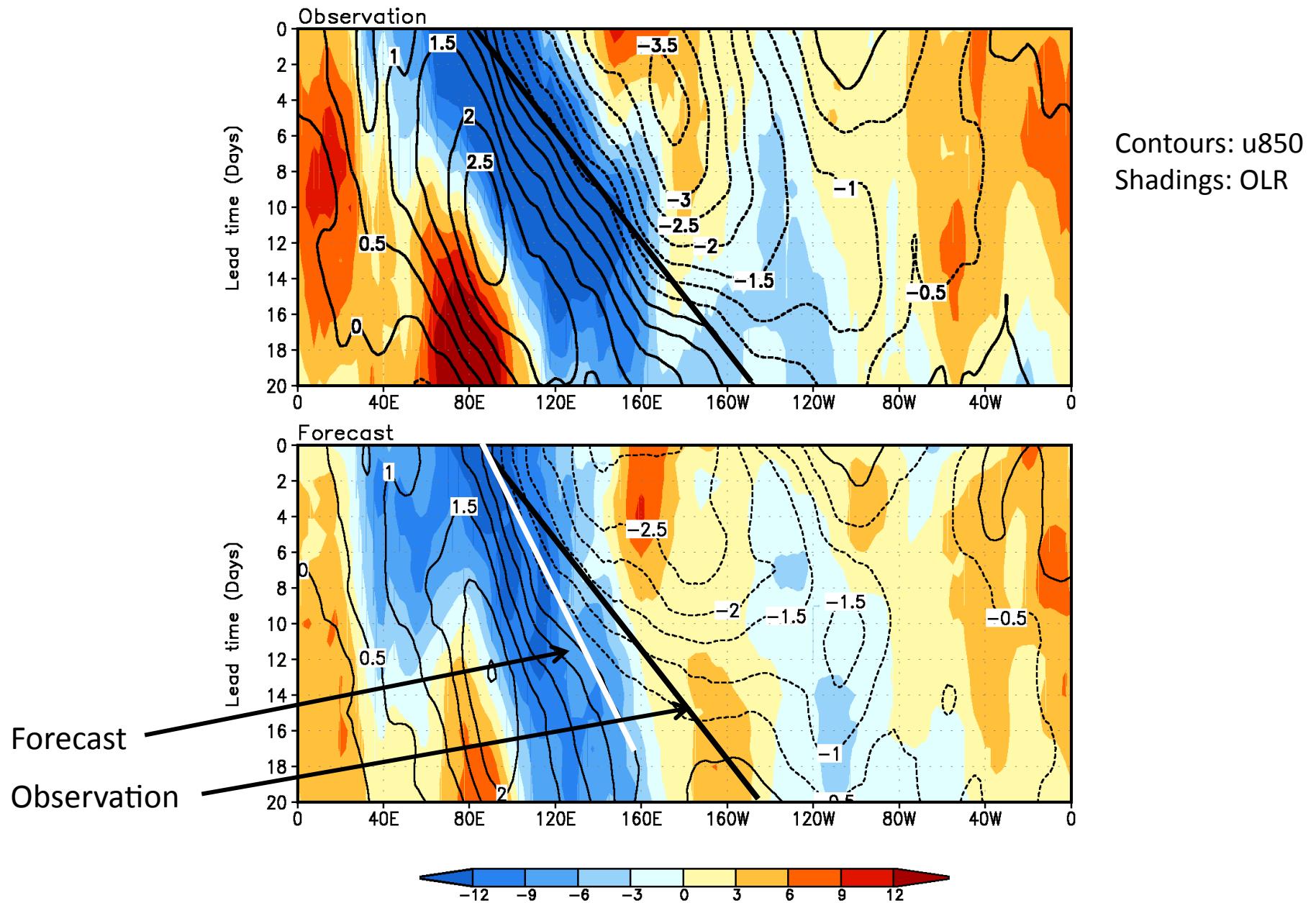
Composites forecast for each initial phase.



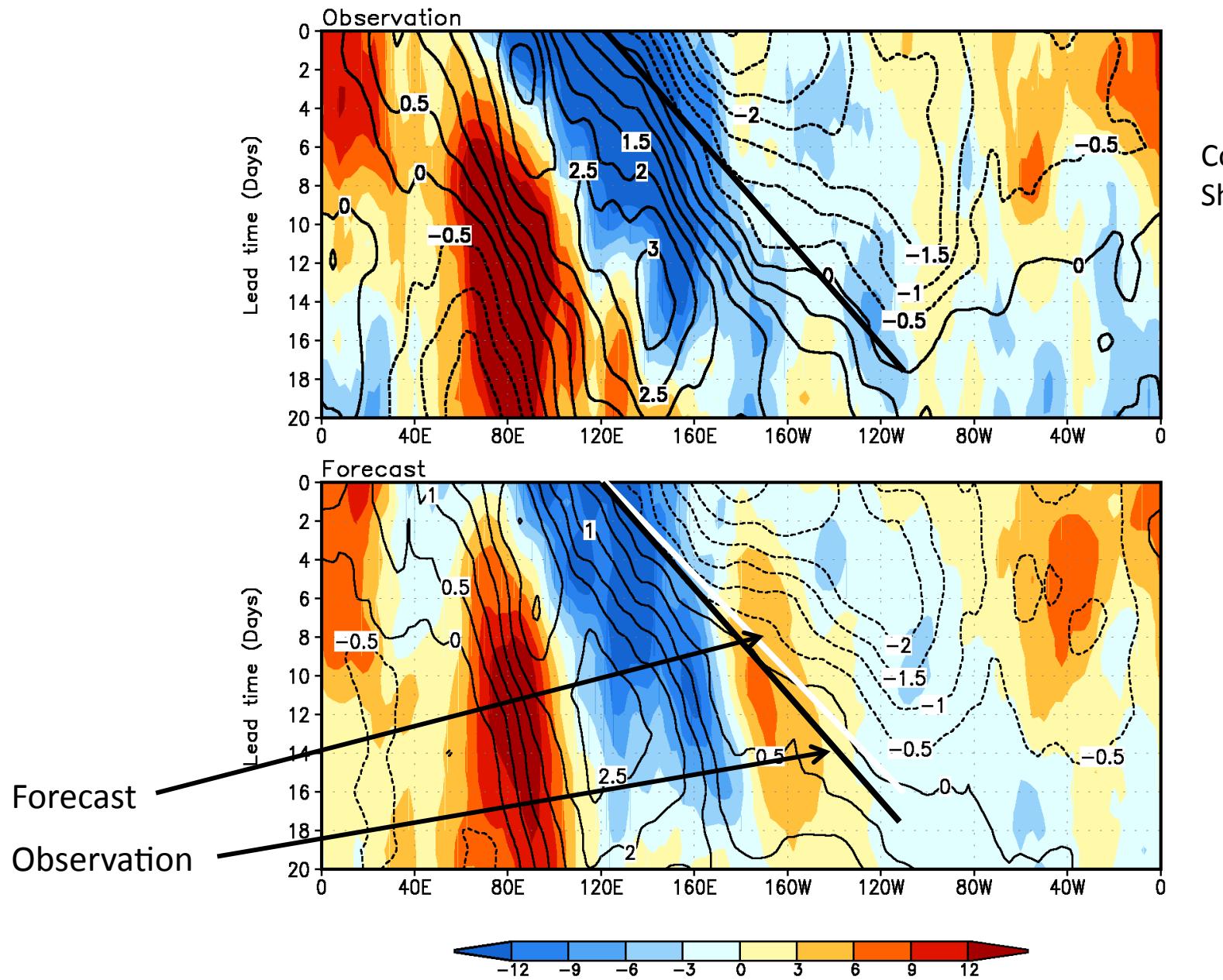
Phase speed (Degree/day)

Initial Phase	1	2	3	4	5	6	7	8
Obs	6.9	6.7	7.4	7.6	6.7	7.2	7.2	6.4
(CFSv2-obs)	(-1.7)	(-1.2)	(-1.2)	(-0.5)	(-1.3)	(-2.0)	(-1.2)	(-1.3)

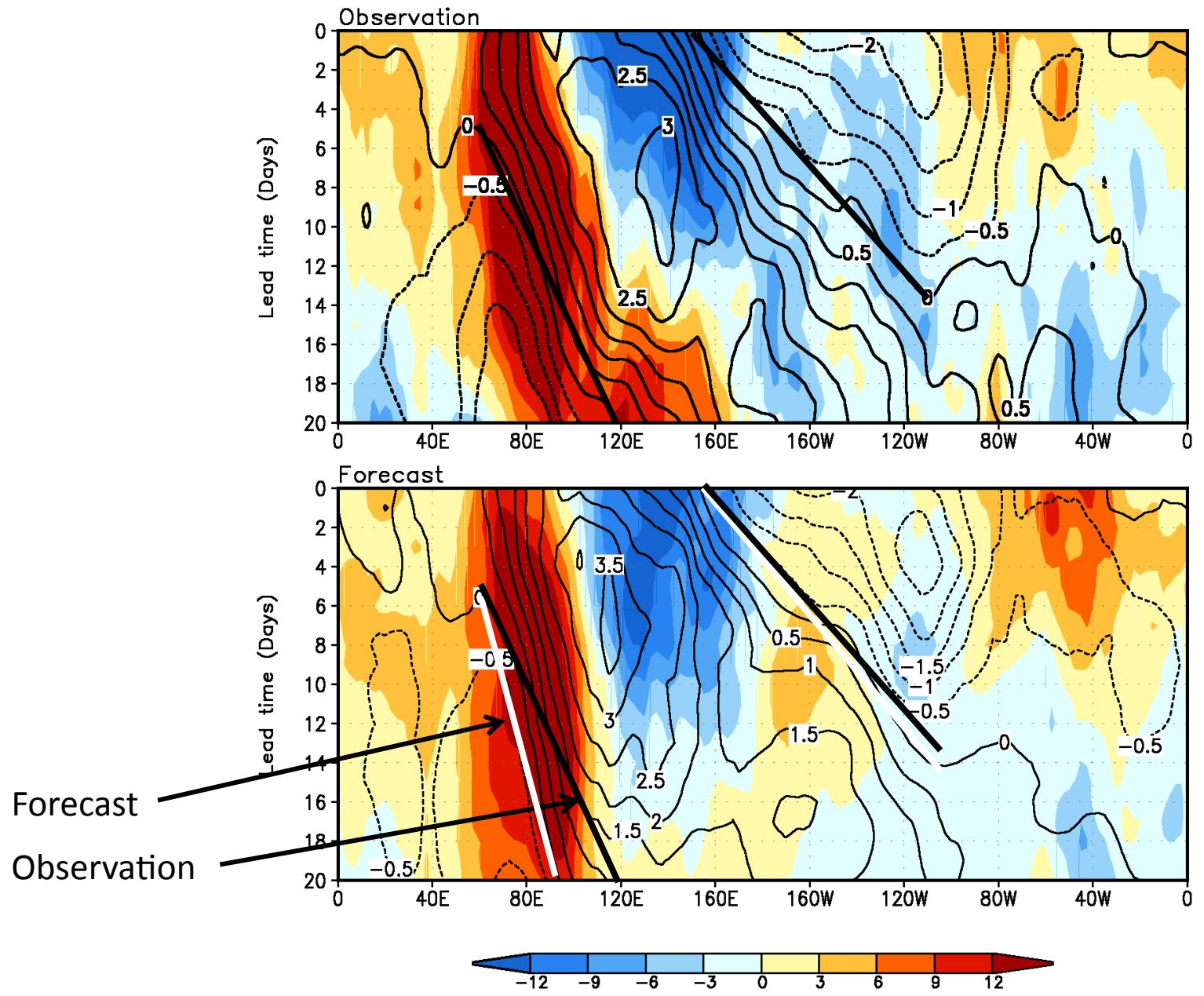
Composite from initial phase 3



Composite from initial phase 4



Composite from initial phase 5

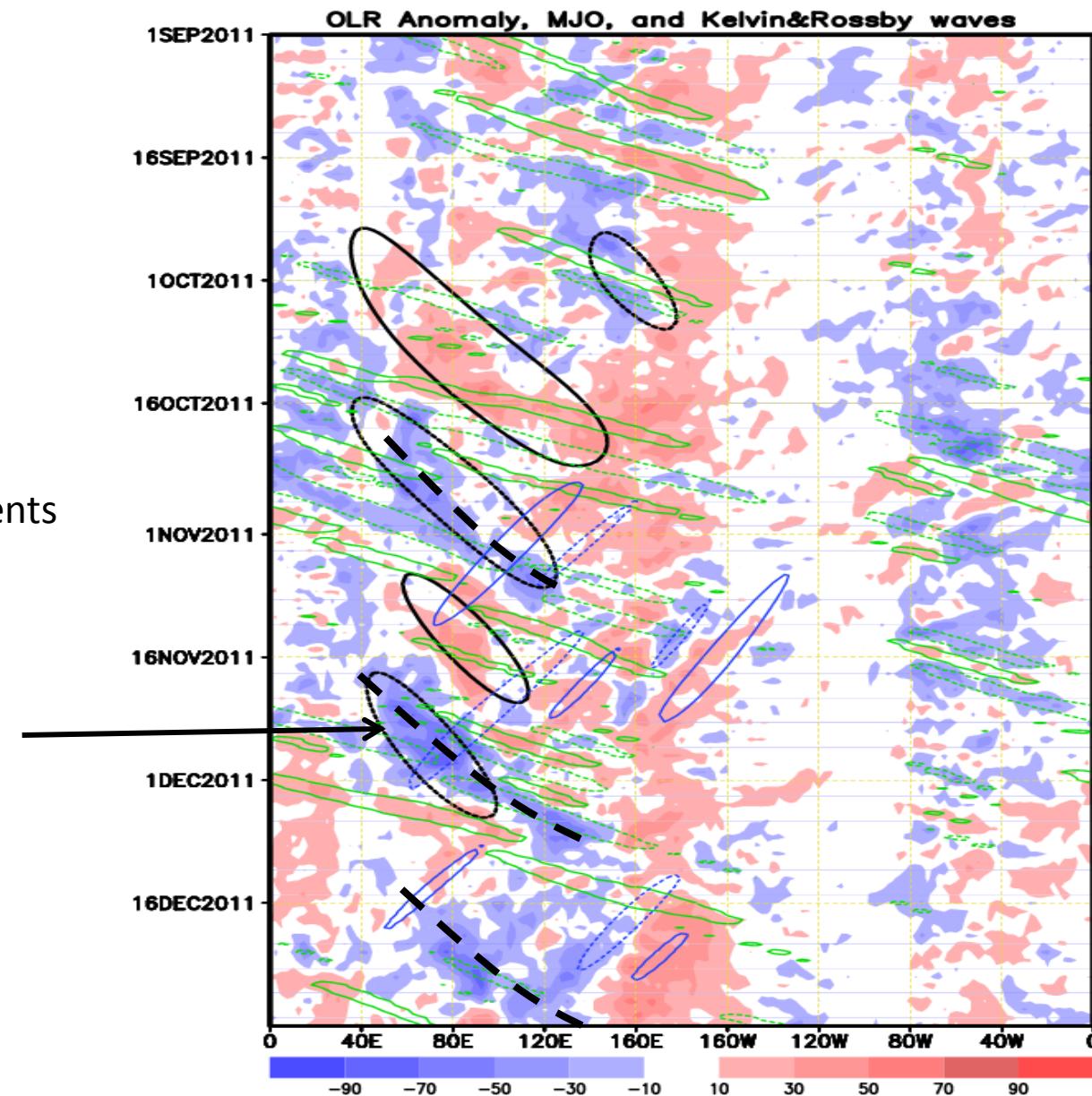


Contours: u850
Shadings: OLR

DYNAMO

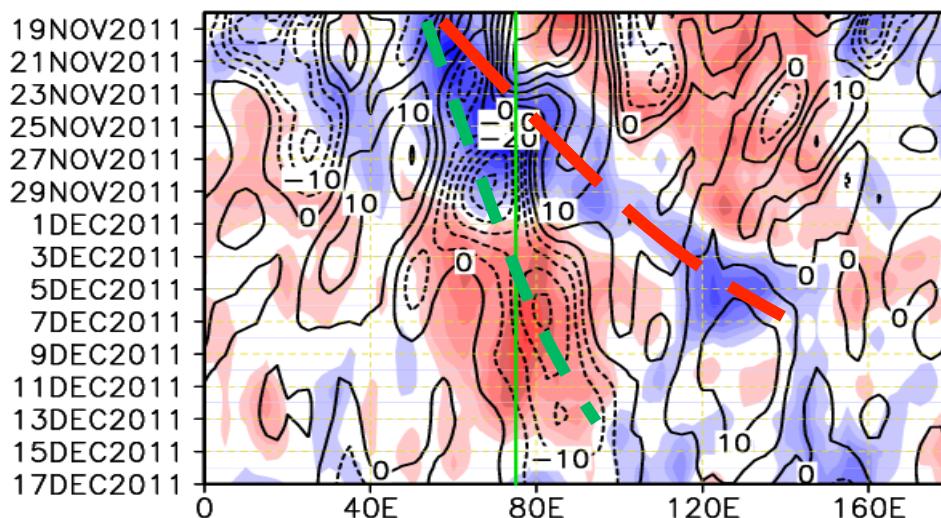
Observed OLR (10S-10N average)

Three MJO events
in OND 2011



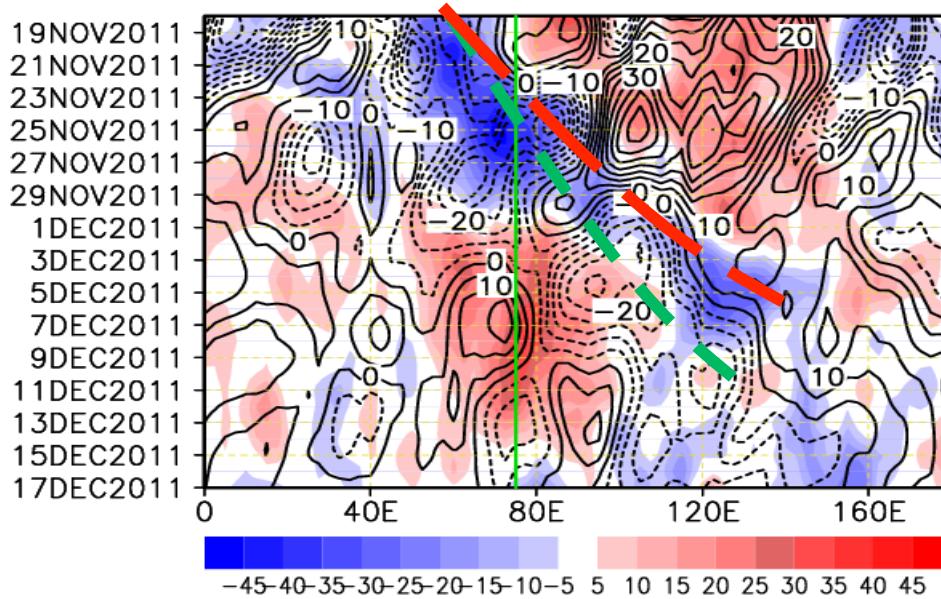
OLR anomalies from November 18th to December 17th

(a) OBS vs. CFSv2



- Too slow eastward propagation, especially in CFSv2
- Unable to propagate across the Maritime Continent in CFSv2

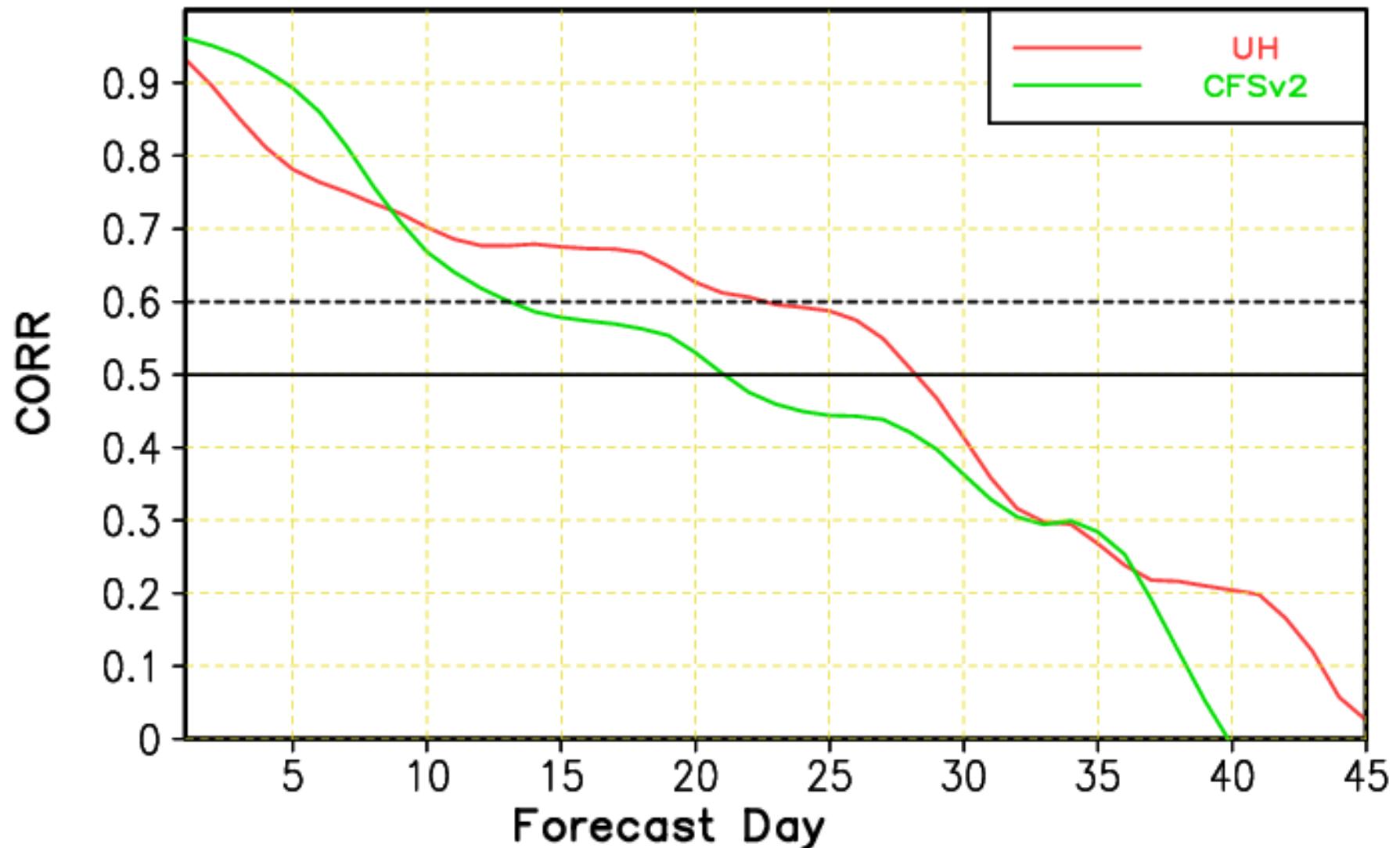
(c) OBS vs. UH



UH Model:
ECHAM 4 coupled to UH ocean model and CFSR for IC.

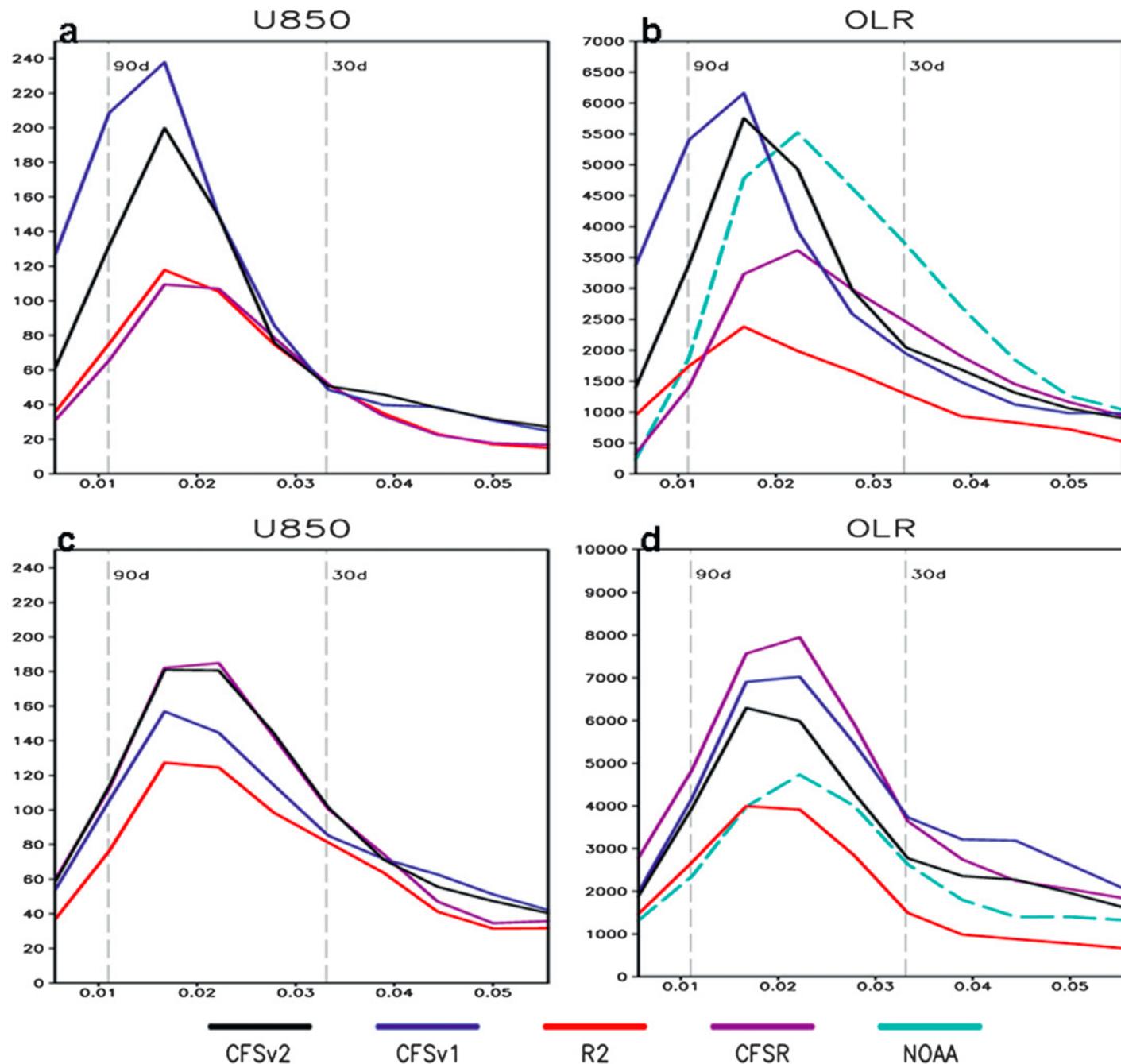
Shadings: Observed
Contours: Forecast

Bivariate correlation during DYNAMO

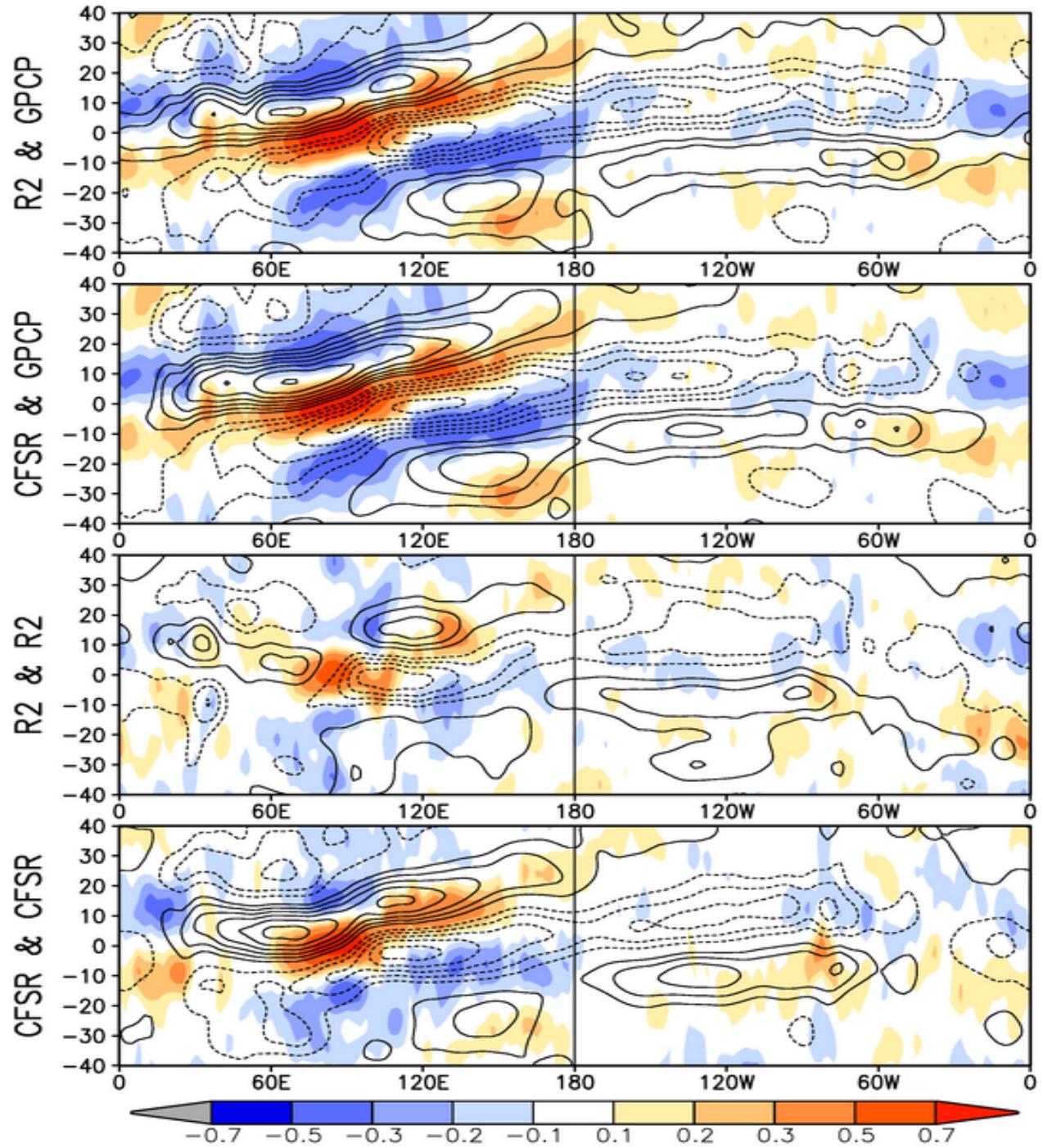


Closing Remarks

- CFSv2 prediction skill is about 20 days, improved compared to CFSv1. Less skillful for convection than dynamic fields.
- Low skill for crossing MC, initialization, and reamplification.
- CFSv2 MJO amplitude is weaker than observed, especially during early forecast period, likely a result of weaker convection in the model.
- Propagation in CFSv2 is still too slow. There is room for further enhancement with improved model physics.



**Lag Correlation
(days):
20-100dy filtered
anoms.
U850 vs Prec.
(10S-10N 70-100E)**



Variation of MJO forecast skill

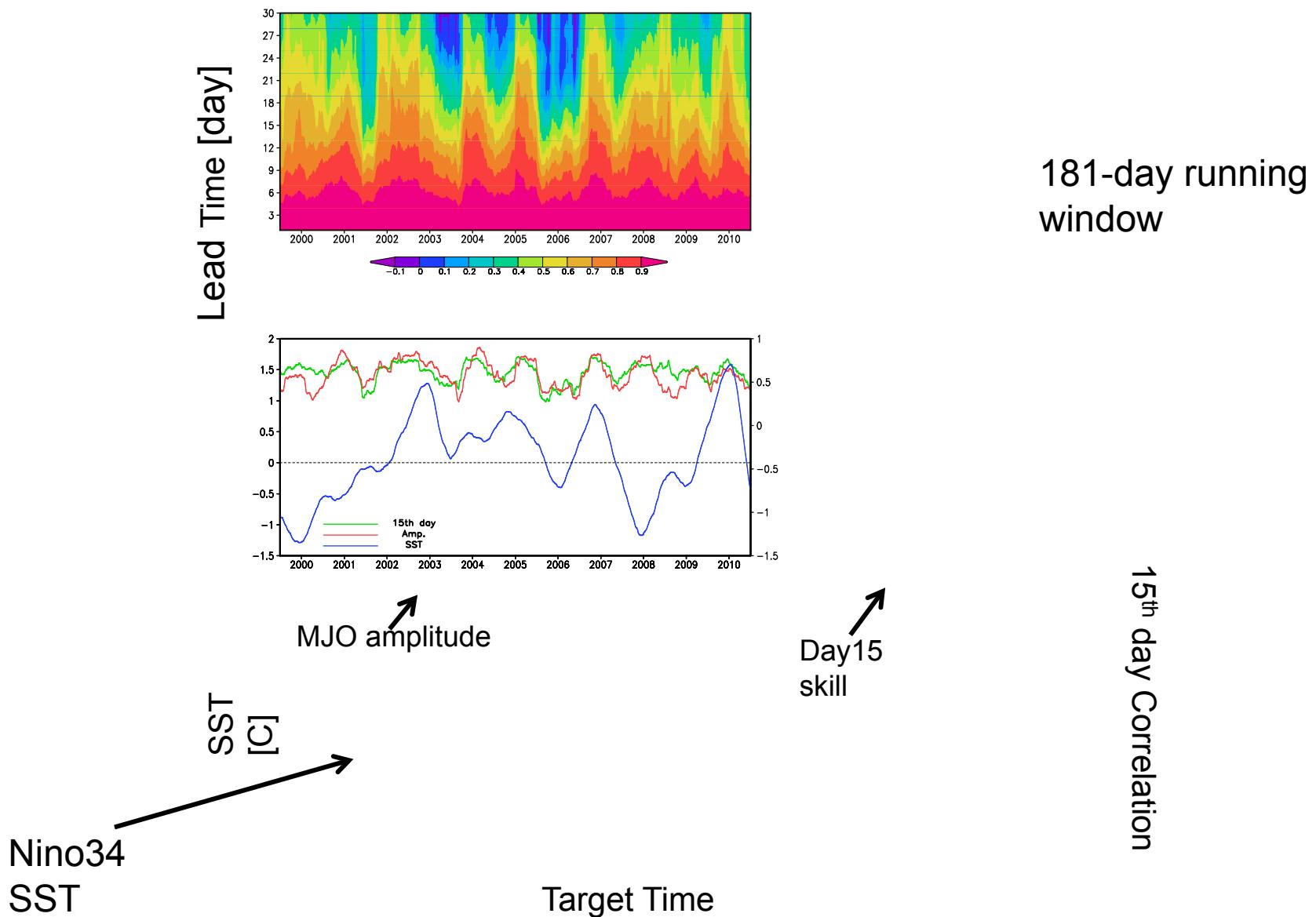


Fig. 5. Variation of MJO forecast skill

Climate Forecast System

	CFSv1	CFSv2
<i>Coupling</i>	Daily	$\frac{1}{2}$ Hourly
<i>Resolution</i>	T62	T126
<i>Ocean</i>	MOM3	MOM4
<i>Land</i>	OSU 2-L	NOAH 4-L
<i>IC atm</i>	R2	CFSR
<i>IC ocn</i>	GODAS	CFSR

Variables: U850, U200, OLR

Hindcasts: 01Jan99 – 31Dec10

4 members/day out to 45 days.

Observations: U850/U200 - CFSR OLR - NOAA/AVHRR

Intraseasonal Anomalies: $F' = F - F_c - F_L$

Where: F (total field) F_c (daily Climo) F_L (Previous 90-day anomaly)